

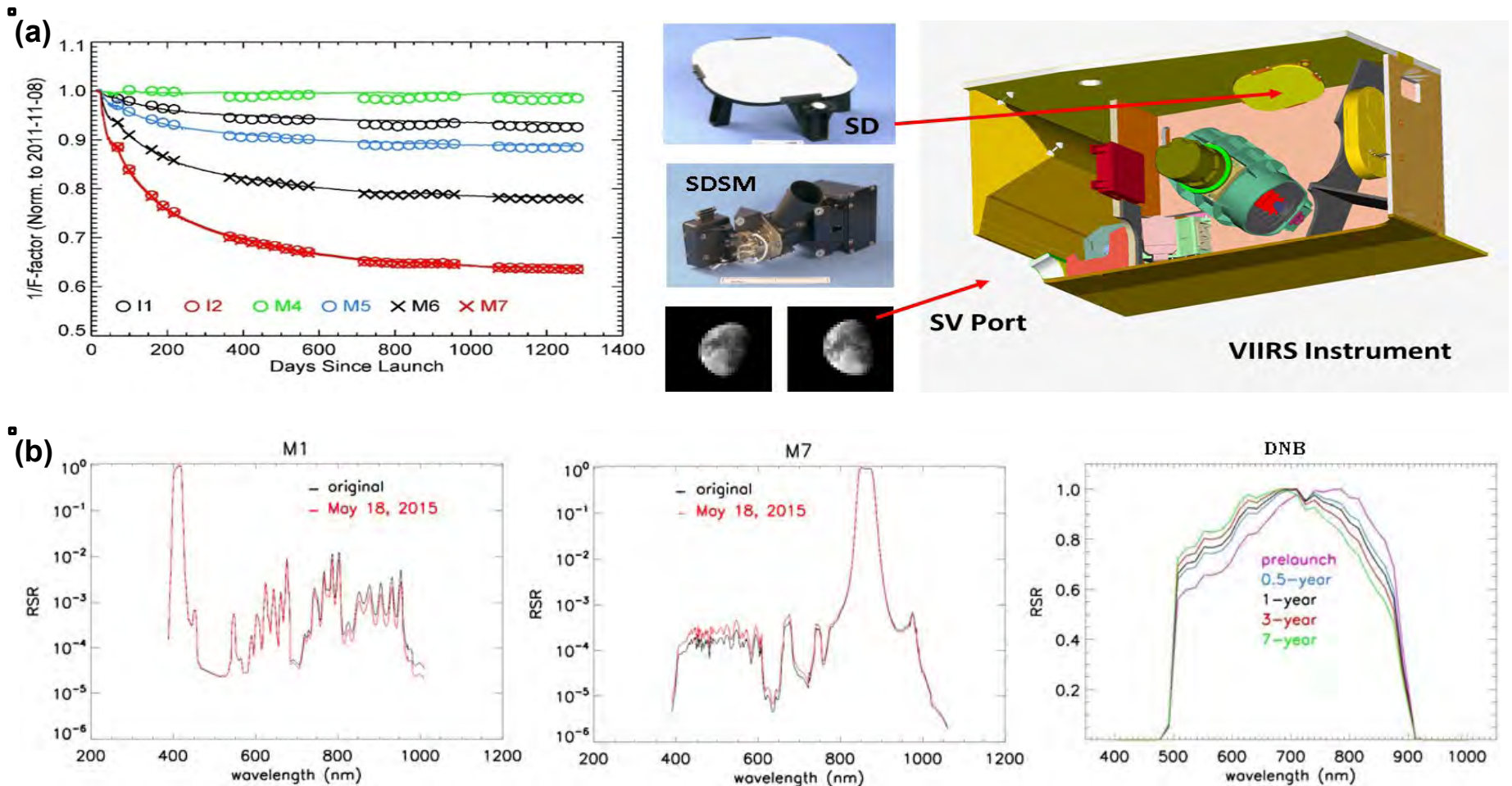


# Improving S-NPP VIIRS Reflective Solar Bands On-orbit Calibration

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**Time- and wavelength-dependent degradation of S-NPP VIIRS reflective solar bands has led to on-orbit derivation and use of modulated relative spectral responses (RSR).**



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## References:

Xiong X., J. Butler, K. Chiang, B. Efremova, J. Fulbright, N. Lei, J. McIntire, H. Oudrari, J. Sun, Z. Wang, and A. Wu, 2014: VIIRS On-orbit Calibration Methodology and Performance. *Journal of Geophysical Research*, Vol. 119, Issue 9, pp 5065-5078, DOI: 10.1002/2013JD02042

Lei, N., X. Xiong, and B. Guenther, 2015: Modeling the Detector Radiometric Gains of the Suomi NPP VIIRS Reflective Solar Bands. *IEEE Transactions on Geoscience and Remote Sensing*, Vol. 53, Issue 3, pp 1565-1573, 10.1109/TGRS.2014.2345481

**Data Sources:** All sensor calibration raw data used in this work are from S-NPP Interface Data Processing Segment (IDPS) via NASA GSFC Level 1 and Atmosphere Archive and Distribution System (LAADS). The lunar calibration reference irradiances are provided by the USGS Robotic Lunar Observatory (ROLO). The pre-launch relative spectral responses are from S-NPP VIIRS pre-launch measurements processed by the NASA VIIRS Characterization Support Team (VCST).

## Technical Description of Figures:

**Graphic a):** S-NPP VIIRS reflective solar band (RSB) responses derived from the instrument on-board SD (lines) and lunar observations (symbols) for bands I1 (600 – 680 nm), I2 (846 – 885 nm), M4 (545 – 565 nm), M5 (662 – 682 nm), M6 (739 – 754 nm), and M7 (846 – 885 nm). A solar diffuser stability monitor (SDSM) is used to track on-orbit changes in SD reflectance property, Regular lunar observations are made through the instrument space view (SV) port in support of RSB on-orbit calibration.

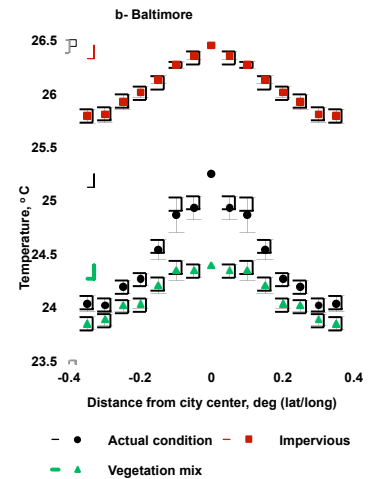
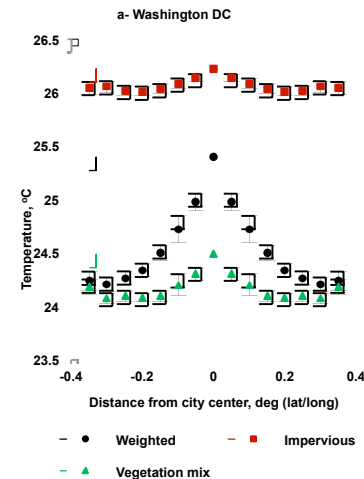
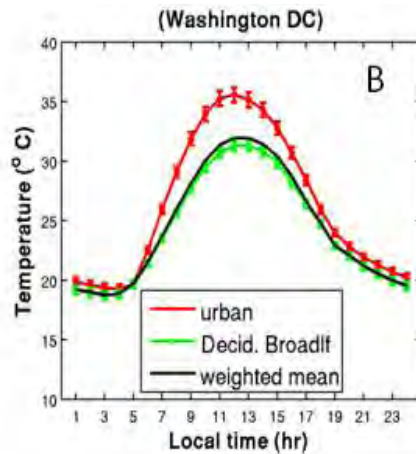
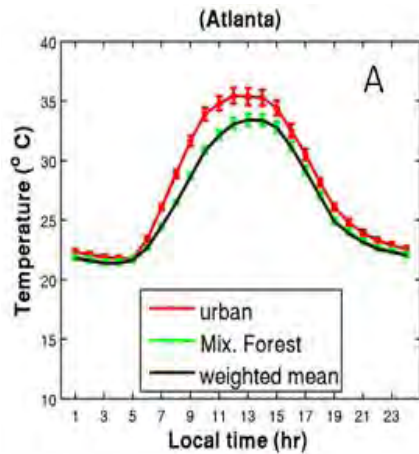
**Graphic b):** S-NPP VIIRS pre-launch measured (marked as original) and on-orbit modulated relative spectral response (RSR) for M1 (402 – 422 nm), M7, and day night band (DNB; 500 – 900 nm). For on-orbit modulated RSR, the out-of-band (OOB) response is relatively smaller than the in-band (IB) response for M1. For M7, the OOB response is relatively larger than the IB response. The changes in DNB IB RSR are much larger than other bands with narrow bandwidths.

**Scientific significance, societal relevance, and relationships to future missions:** The VIIRS instrument was built with a set of on-board calibrators as the quality of its environmental data records (EDRs) strongly depends on the sensor's calibration accuracy. The RSRs are sensor's key performance parameters that are used in both calibration and retrievals. Due to the strong wavelength-dependent degradation of the VIIRS optics, a times-dependent on-orbit modulated RSR becomes necessary for each spectral band in order to maintain its calibration quality. Through the modeling of sensor radiometric gains, the NASA VIIRS Characterization Support Team has produced modulated RSRs of high fidelity for all reflective solar bands (RSB), including the DNB, thereby mitigating the impact of the degradation on both the SD and lunar calibrations.



# Impact of Urbanization on the Continental US Surface Climate

L. Bounoua, P. Zhang, G. Mostovoy, K. Thome, J. Masek, M. Imhoff, M. Shepherd, D. Quattrochi, J. Santanello, J. Silva and R. Wolfe  
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Scientists at NASA use data fusion from Landsat and MODIS to characterize US urbanization and model its impact on surface climate. Impervious surfaces occupy 1.1% of the CONUS area and are warmer than vegetated lands by 1.9 °C during summer (JJA). They expel 12% of precipitation as surface runoff compared to 3.2% over vegetated lands and reduced carbon uptake by 1.8% of the CONUS total.



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### References:

Bounoua L., P. Zhang, G. Mostovoy, K. Thome, J. Masek, M. Imhoff, M. Shepherd, D. Quattrochi, J. Santanello, J. Silva and R. Wolfe: Impact of Urbanization on the US Surface Climate, in review in ERL, manuscript #: 101401.

**Data Sources:** Landsat-based National Land Cover Dataset to characterize the impervious surface area (urban) and MODIS 500m-land cover classification along with the 8-day NDVI used in SiB2 to generate the annual (8-day) biophysical parameters required for the land surface model. The North American Land Data Assimilation System NLDAS-2 are used to force the Biospheric model at half-hourly time step.

### Technical Description of Figures:

**Figure 1:** June-July-August mean diurnal cycle of surface temperature for urban (red), dominant vegetation (green) and the weighted average for all land cover types (excluding urban) (black) for Atlanta (a) and Washington DC (b). These temperatures are simulated by the Simple Biosphere model (SiB2) forced by half hourly meteorological data at 5kmx5km obtained from the North American Land Data Assimilation System NLDAS-2, for the year 2001.

**Figure 2:** Average surface temperature profile across the centers of Washington DC and Baltimore cities for summer (June-July-August). The “**Impervious**” scenario represents the surface temperature if the area was fully (100% ) impervious. The “**Weighted**” scenario represents the average surface temperature weighted by fractions of all existing LC classes including urban (**Actual situation**). The “**Vegetation mix**” temperature profile is obtained by replacing the impervious surface area with a mixture of all vegetation classes co-existing in the area and is a proxy for pre-urban “**Pre-Urban**”.

### Scientific significance, societal relevance, and relationships to future missions:

#### Scientific significance:

- Urbanization has conflicting attributes, small area but high ecological impact
- Transpiration cooling is an important modulator of surface temperature.
- In the US urbanization reduced carbon uptake by 1.8% and contributed an average summer warming of 1.9°C.

#### Societal Relevance:

US cities are home to more than 50% of the population and this is where climate change will be felt the most.

Urban communities will be interested to know how cities interact with climate and the scientific community is interested to include the urban ecosystem functions in climate models.

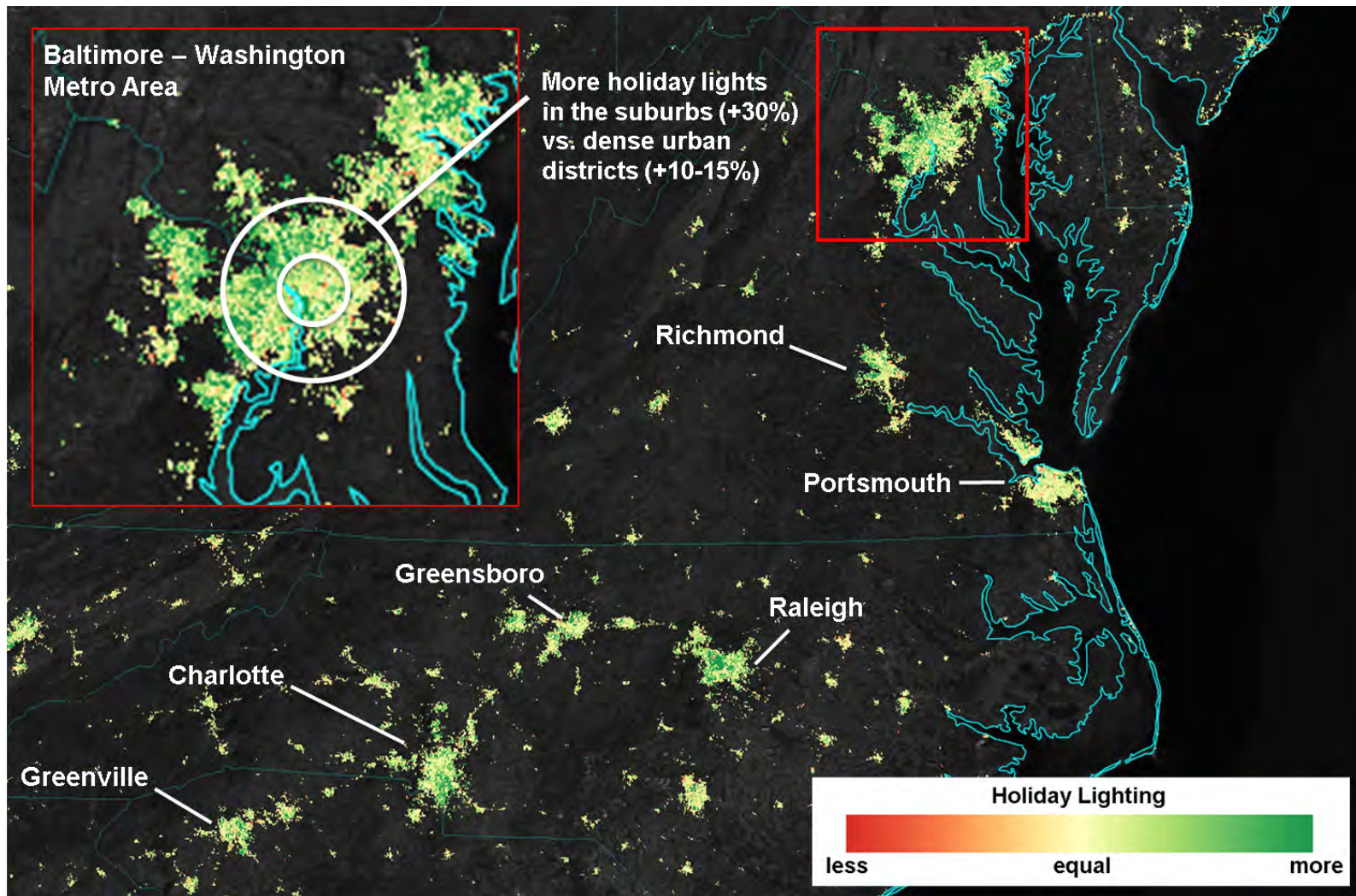
**relationships to future missions :** Defines the need for a high resolution global mapping of urban settings to assess their interaction with the global environment.





# Holidays in lights: Tracking cultural patterns in demand for energy services

Miguel Román, Terrestrial Information Systems, NASA GSFC; Eleanor Stokes, Yale/FES



**What Do Holiday Lights Look Like From Space?** City lights shine brighter during the holidays in the United States when compared with the rest of the year, as shown using a new analysis of nighttime lights data from Suomi-NPP VIIRS. (Román and Stokes, 2015)



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### References:

Román, M. O. and Stokes, E. C. (2015), Holidays in lights: Tracking cultural patterns in demand for energy services. *Earth's Future*. doi:10.1002/2014EF000285.

**Data Sources:** The latest science reprocessing (Collection V1.1) of the Suomi-NPP Visible Infrared Imaging Radiometer Suite (VIIRS) Sensor Data Records (SDRs), Land Intermediate Products (IPs), and Environmental Data Records (EDRs) was used in this study. These data sets employ the best available VIIRS instrument calibration and characterization results, as well as the latest available algorithm changes applied to the beginning of the VIIRS science mode operation (19 January 2014). All VIIRS data sets, quality assessment reports, and processing tools are publicly available (<http://viirsland.gsfc.nasa.gov/>).

**Technical Description of Figure:** City lights shine brighter during the holidays in the United States when compared with the rest of the year, as shown using a new analysis of daily nighttime data from the VIIRS instrument onboard the NASA/NOAA Suomi NPP satellite. Dark green pixels are areas where lights are 30 percent brighter, or more, during December. Because snow reflects so much light, only snow-free cities were analyzed. Holiday activity is shown to peak in the suburbs and peri-urban areas of major Southern US cities, where Christmas lights are prevalent. In contrast, most central urban districts, with compact dwelling types affording less space for light displays, experience a slight decrease or no change in energy service demand.

**Scientific significance, societal relevance, and relationships to future missions:** Our findings demonstrate that dynamic nighttime monitoring using the VIIRS instrument on Suomi-NPP provides us with a uniquely human view of cities. We can look at things that we couldn't look from daytime images. Things related to human drivers of energy use, social drivers, and cultural drives. VIIRS can detect Christmas Lights from Space. These measurements are providing us with a completely new perspective of the Earth System – a human perspective. This initial results demonstrate the importance of seating energy demand frameworks in a social context. As the time-series of science-quality nighttime products expands into the JPSS era (> 2030), these measurements will enrich research on the relative importance of global drivers of energy demand and conservation behaviors at fine spatial scales.